

An Approach to Assess Inequality in Cumulative Impacts



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Cumulative Impact Assessment

To address:

- **Multiple factors**

in a geographic area from combined emissions and discharges, from all sources, whether single or multi-media, routinely, accidentally, or otherwise released

- **Vulnerability**

to take into account sensitive populations and socio-economic factors



Issues In Cumulative Impacts Assessment

INPUTS

What do we measure?

- Hazard
- Vulnerability
- Resilience
- Susceptibility

IMPACT

How do we measure and cumulate hazards?

- Exposure
- Emissions
- Hazard location
- Risk
- Health impact
- Benchmark exceedance
- Population mean

Geographic scale

Neighborhood
Region

INEQUALITY

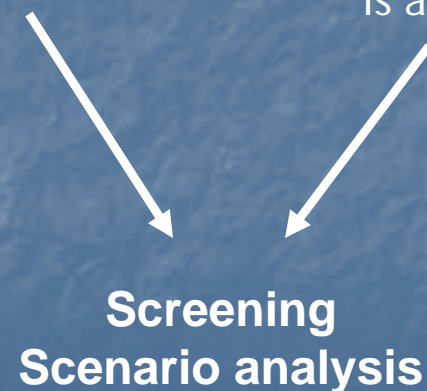
Who bears the burden?

- Demographic disparities (e.g. SES, race/ethnicity)
- Within regions
- Between regions
- Between different SES measures

TARGETING

What are priorities for intervention?

- Where impact is high
- Where vulnerability is high
- Where inequality is high
- When emissions reduction technology is available



Issues In Inequality Assessment

INEQUALITY

Who bears the burden?

- Demographic disparities (e.g. SES, race/ethnicity)
- Within regions
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TARGETING

What are opportunities for intervention?

- Where impact is high
- Where vulnerability is high
- Where inequality is high



Screening & Scenario analysis

Objectives of Inequality Assessment

- Derive methods that are transparent and scientifically sound
- Compare impacts and socio-demographic inequalities between and within regions
- Develop indicators that highlight inequality and CI impacts of potential policy interventions

Inequalities between and within regions

- Regional land use and economic development decisions often drive neighborhood impacts
- Exposure differences exist between regions
 - (e.g. LA versus San Francisco ozone levels)
- Inequality patterns among neighborhoods and socio-demographic groups differ between regions
- Necessitates both regional and neighborhood level assessments

Inequality Assessment: Air Toxics Example

- **Three regions:** estimated lifetime cancer risk from multiple ambient air toxics exposures
 - Los Angeles
 - San Diego
 - San Francisco
- Absolute inequalities across regions
- Inequality across different SES measures within regions
- Assessing potential policy interventions on inequality and CI

U.S. EPA's National Air Toxics Assessment (NATA)

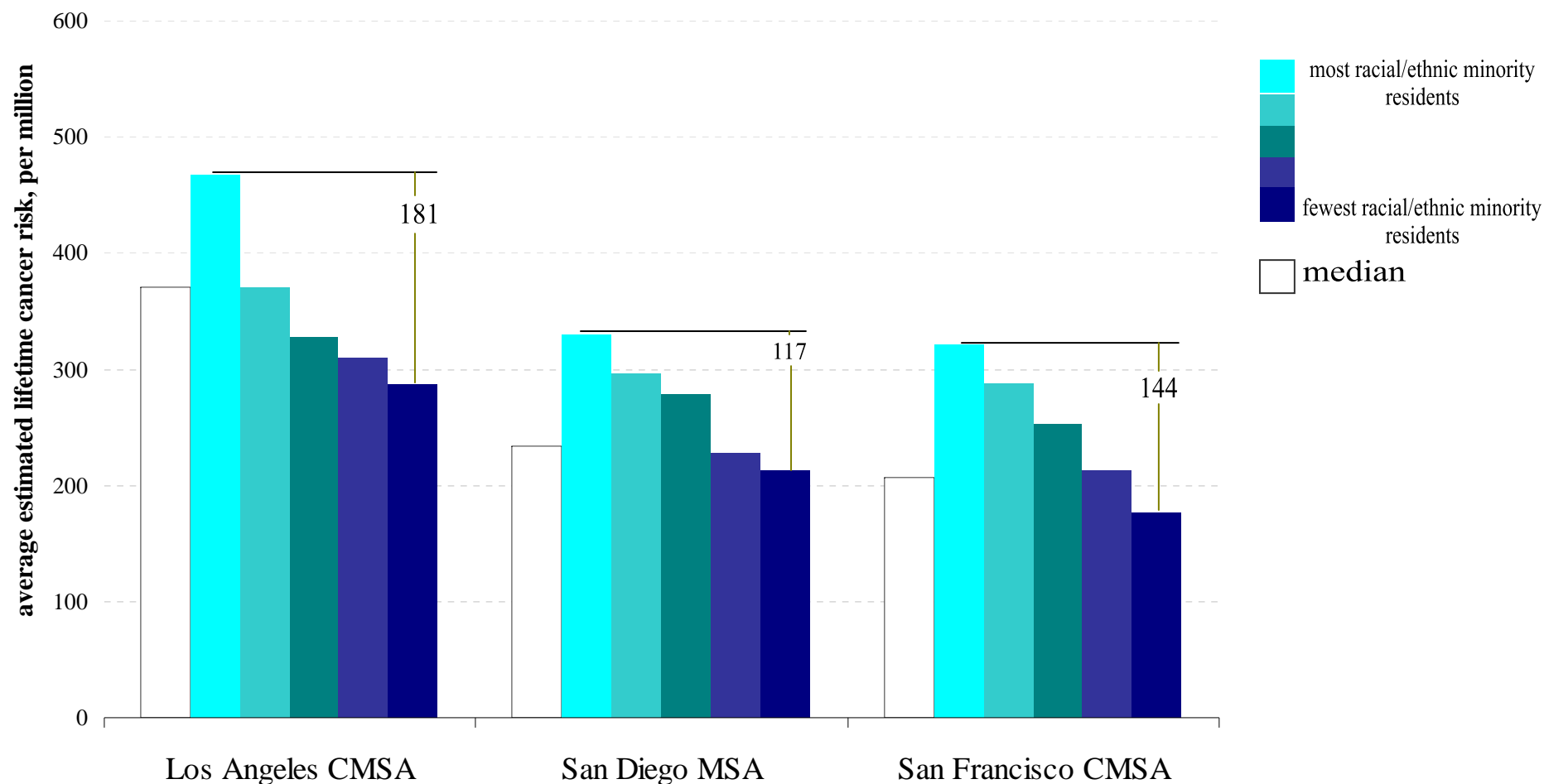
- Dispersion model estimates long-term annual average outdoor air toxics and diesel particulate concentrations for 1999 for each census tract in the US
- Model includes mobile and stationary emissions sources, including:
 - Manufacturing (e.g. refineries, factories)
 - Non-Manufacturing (e.g. dry cleaners, chrome platers)
 - Mobile (on road and off road)
- NATA used as example only
 - Inequality assessment is flexible and can be applied to different metrics of cumulative impact or for single pollutants

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Absolute inequalities across regions: Race/ethnicity

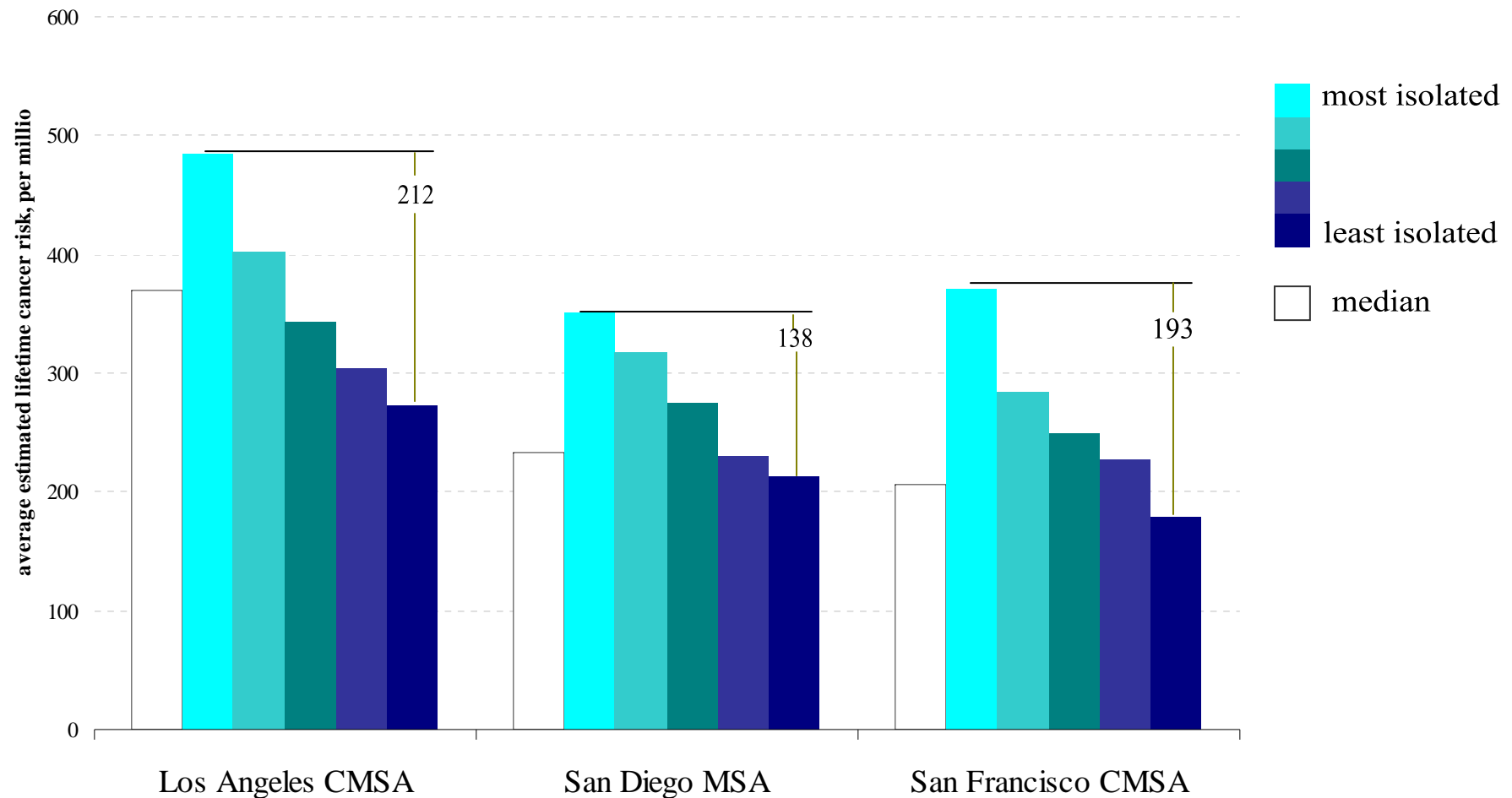
cumulative air toxics cancer risk between
highest and lowest proportion of racial/ethnic minority residents



Note: SES categories based on statewide distribution

Absolute inequalities across regions: Linguistic isolation

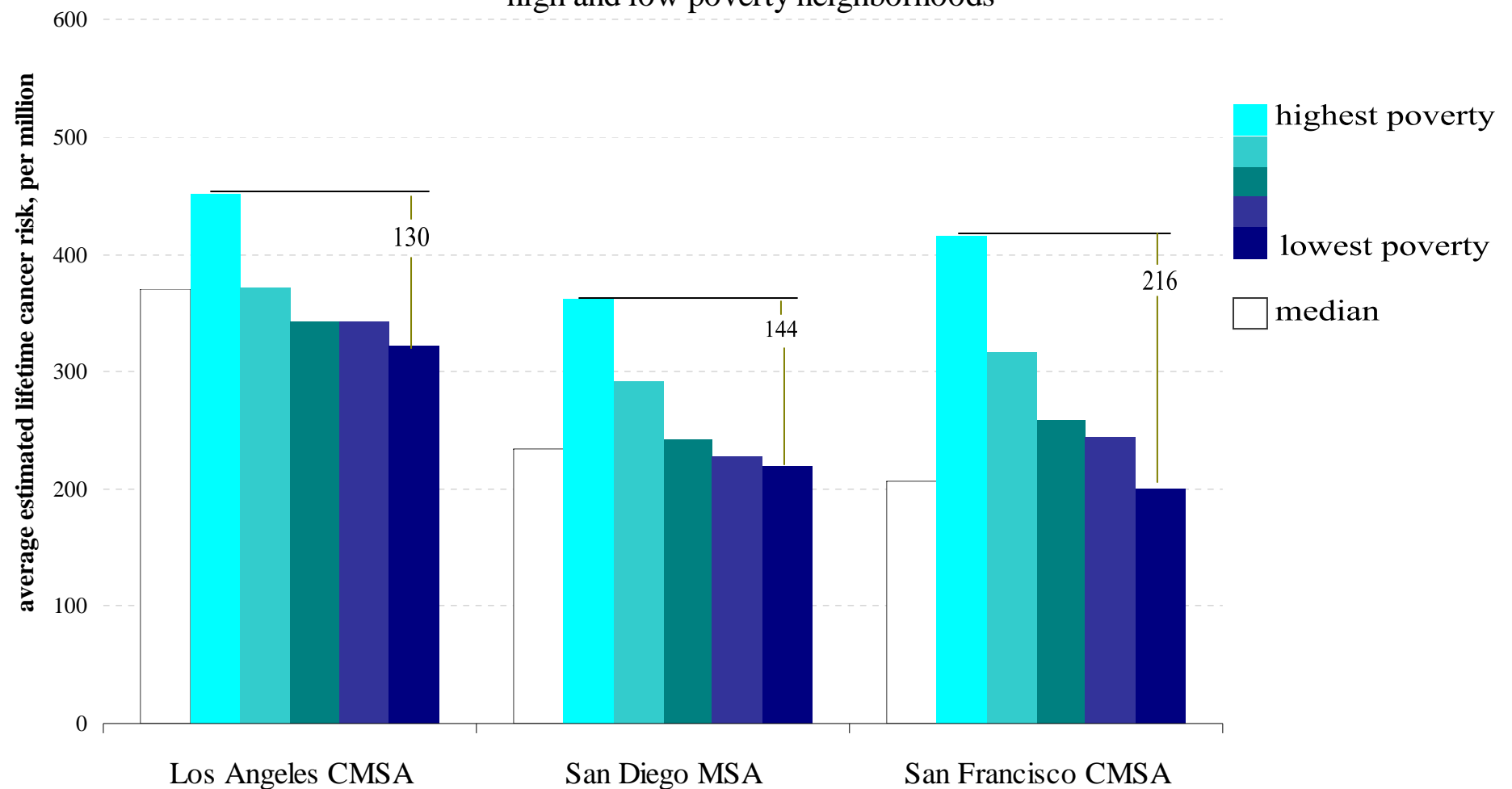
cumulative air toxics cancer risk between
linguistically isolated and English-language dominant neighborhoods



Note: SES categories based on statewide distribution

Absolute inequalities across regions: Poverty rate

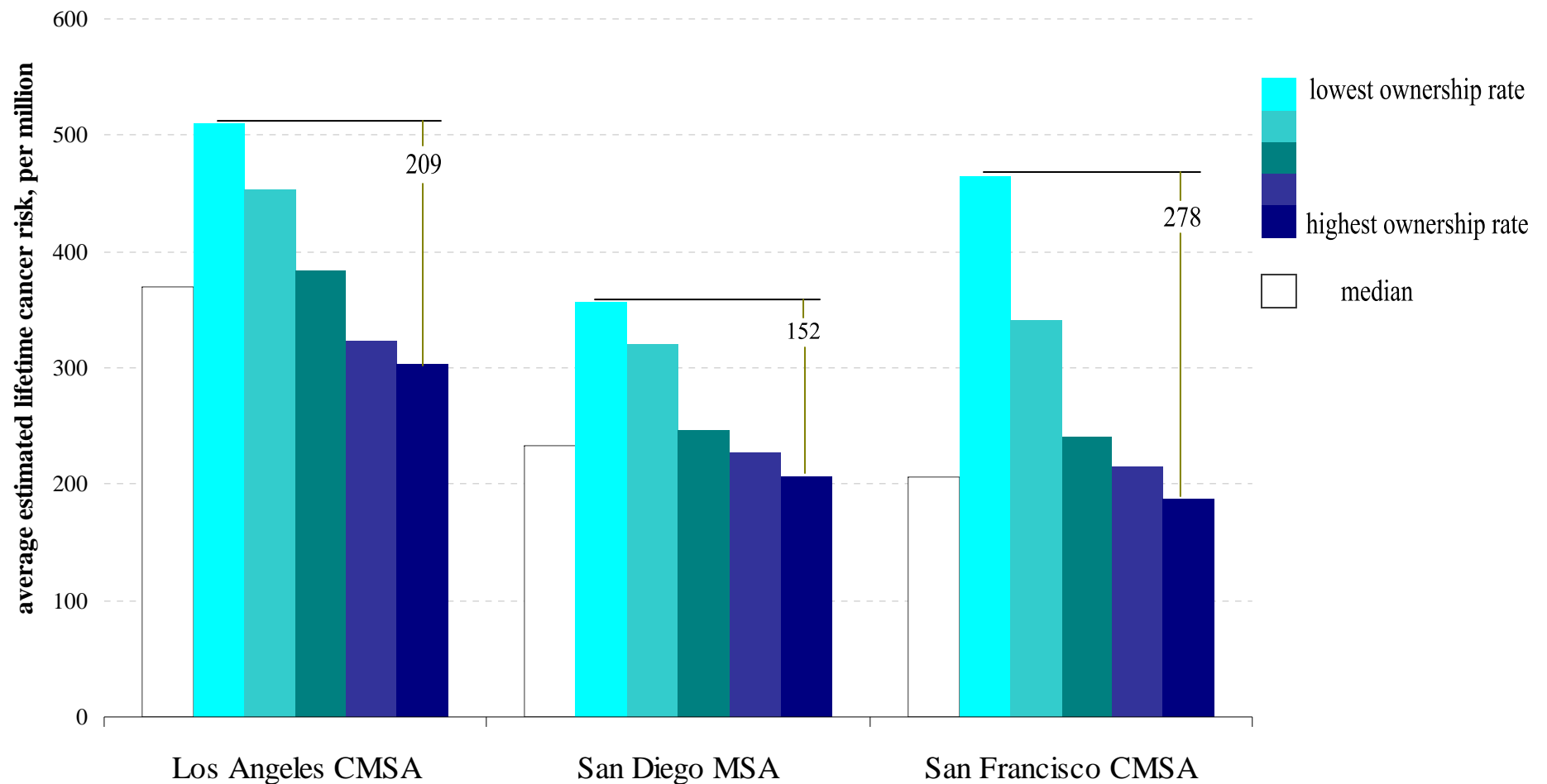
cumulative air toxics cancer risk between
high and low poverty neighborhoods



Note: SES categories based on statewide distribution

Absolute inequalities across regions: Home ownership

cumulative air toxics cancer risk between
high and low home ownership rate neighborhoods



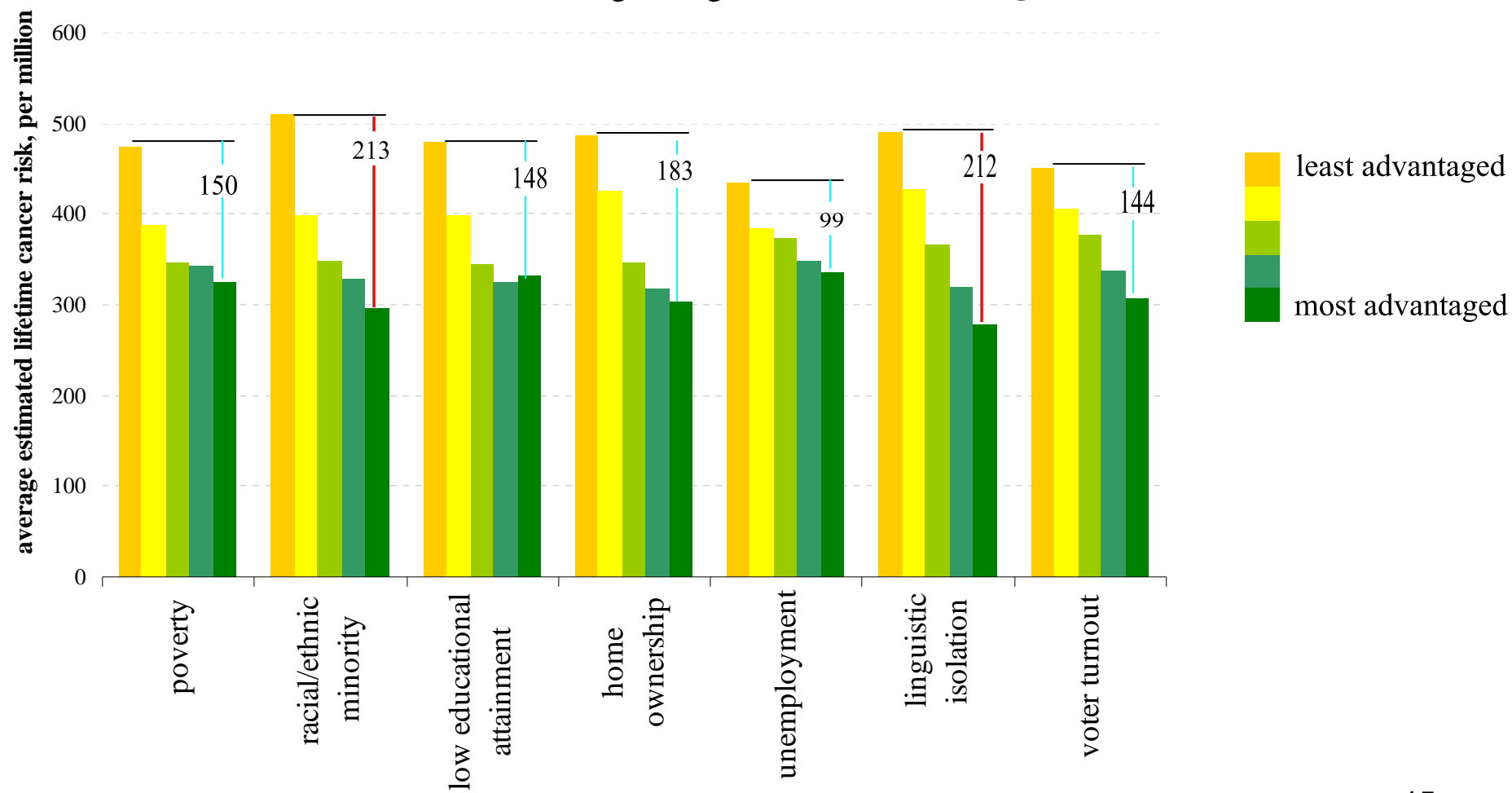
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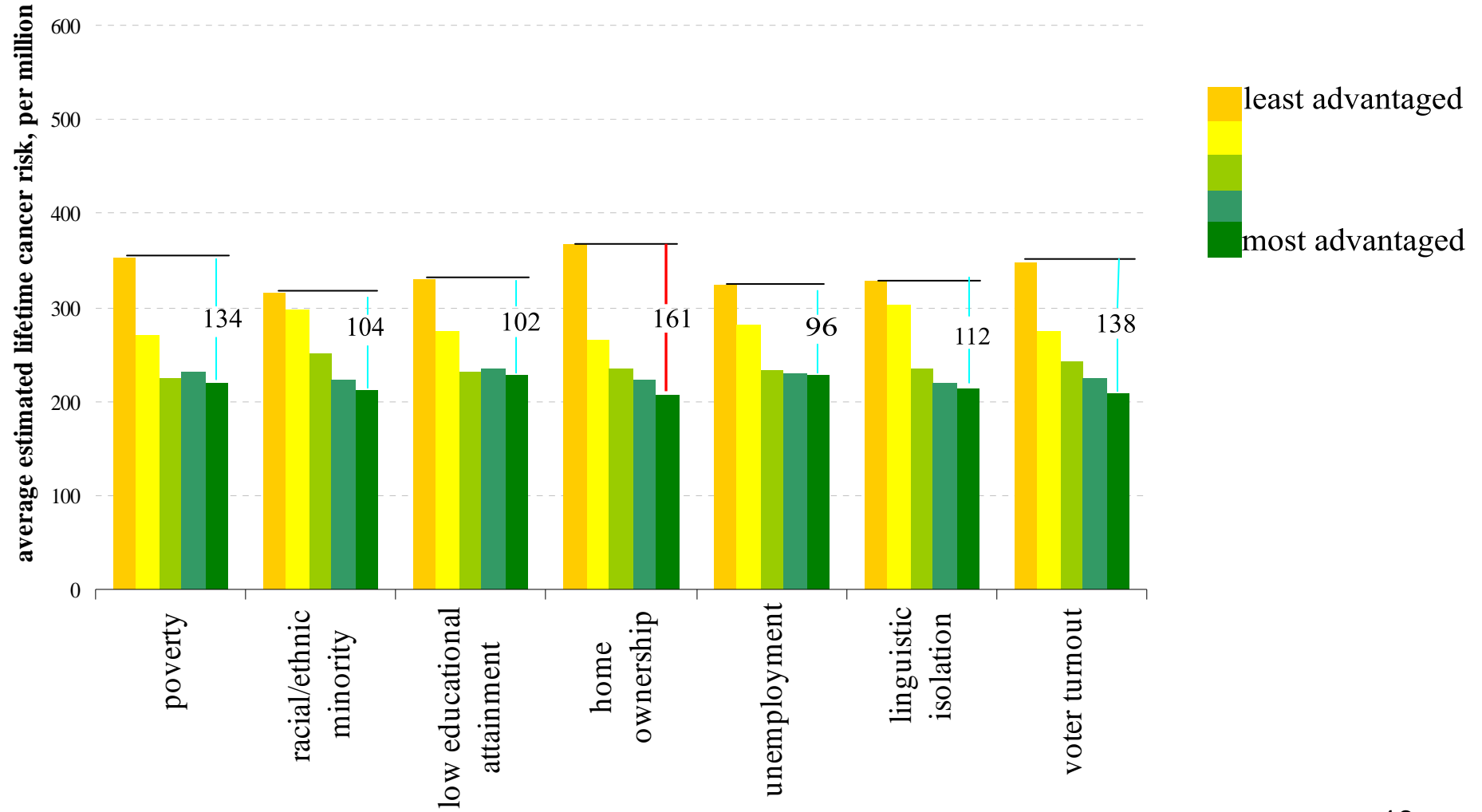
Inequality across different SES measures within regions

cumulative cancer risk from air toxics between
least and most advantaged neighborhoods in **Los Angeles** CMSA



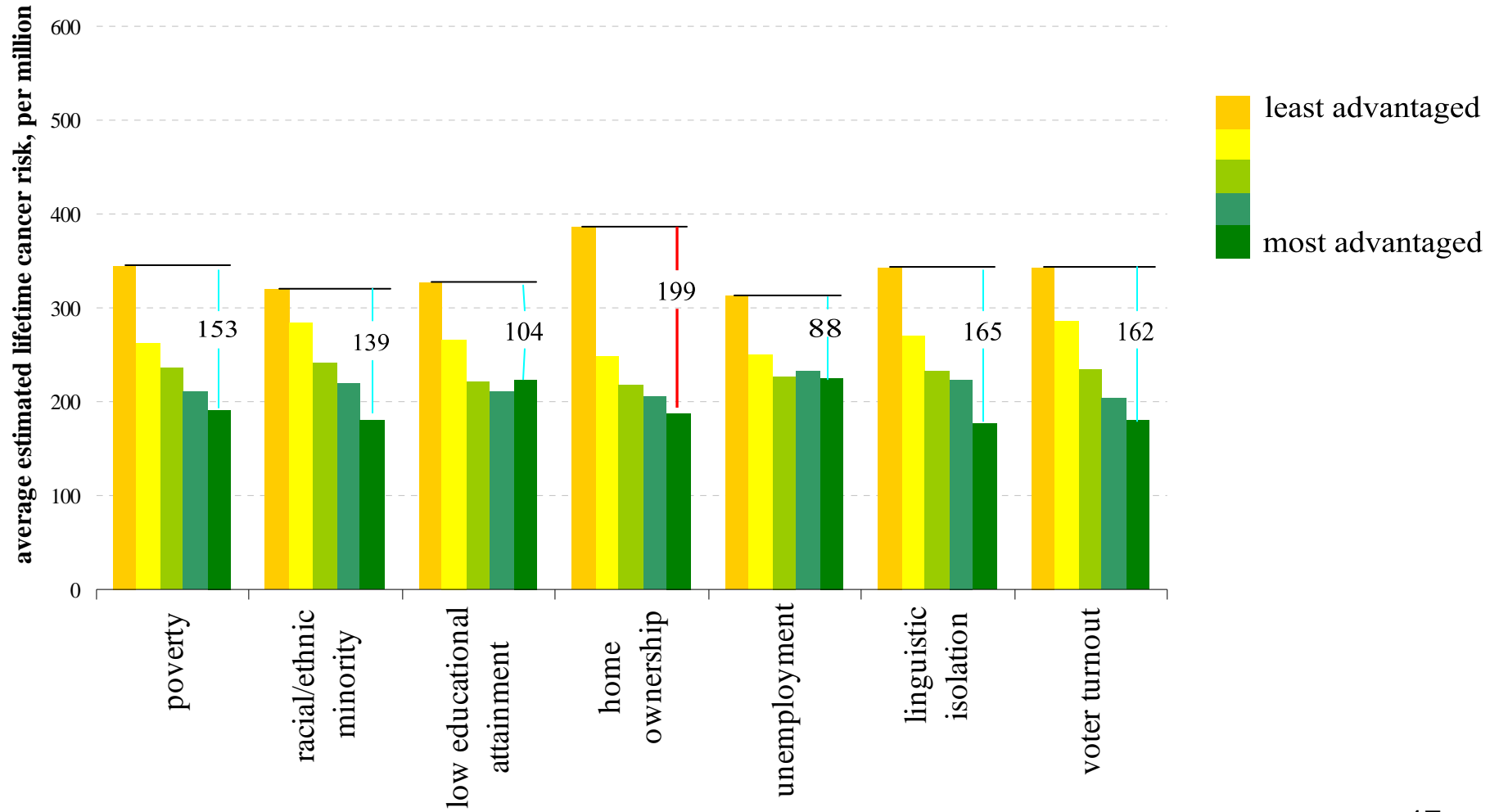
Inequality across different SES measures within regions

cumulative cancer risk from air toxics between
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Inequality across different SES measures within regions

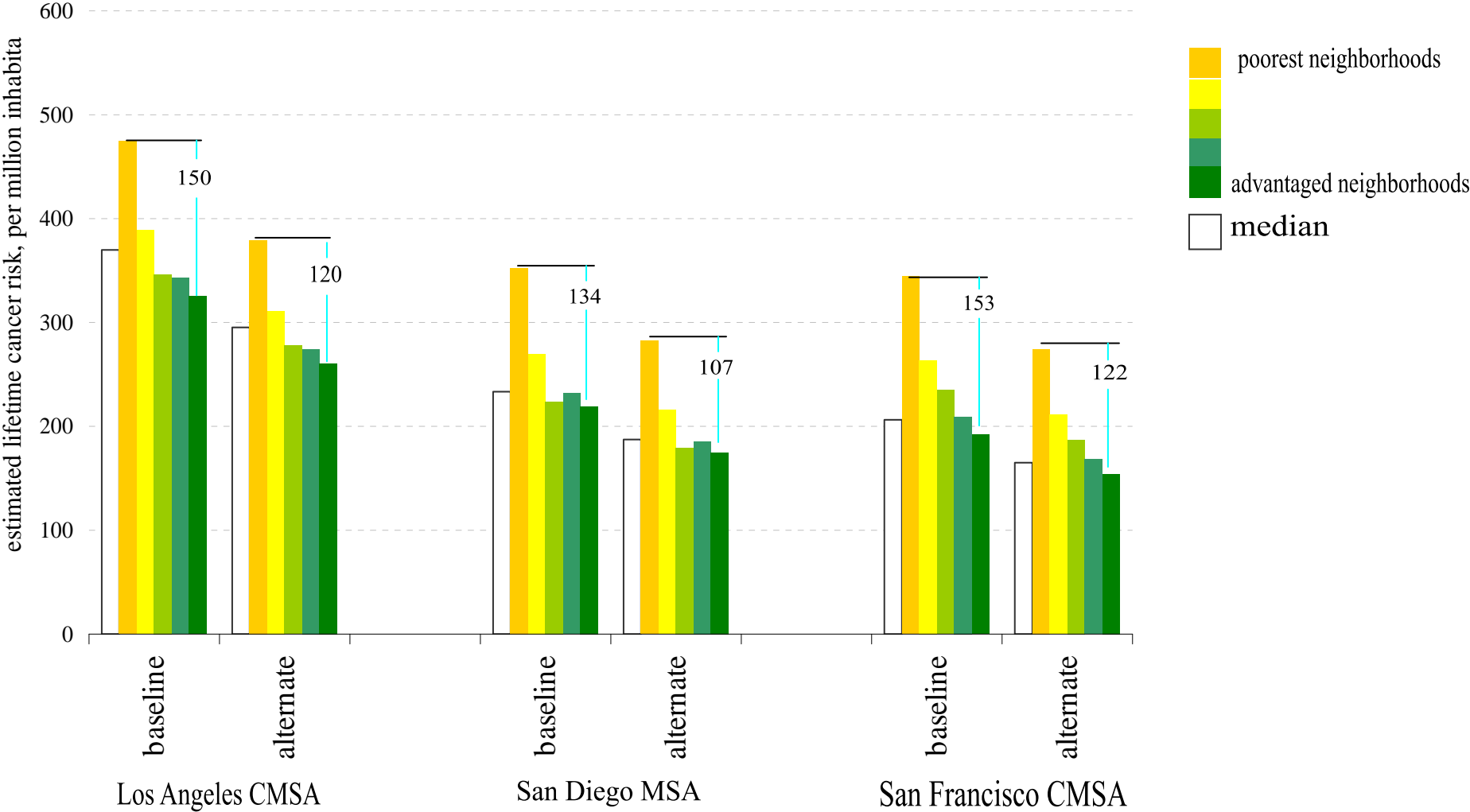
cumulative cancer risk from air toxics between
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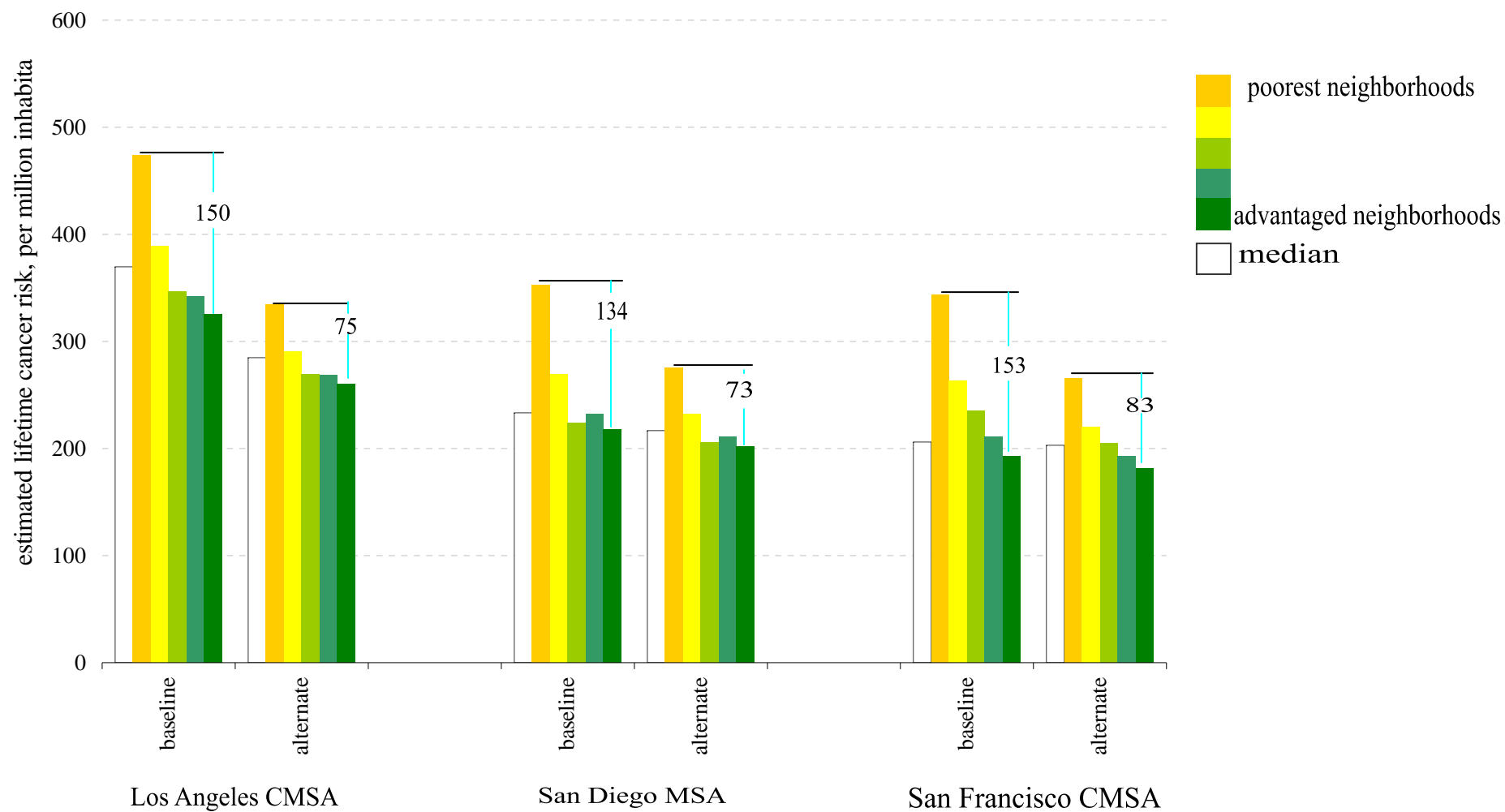
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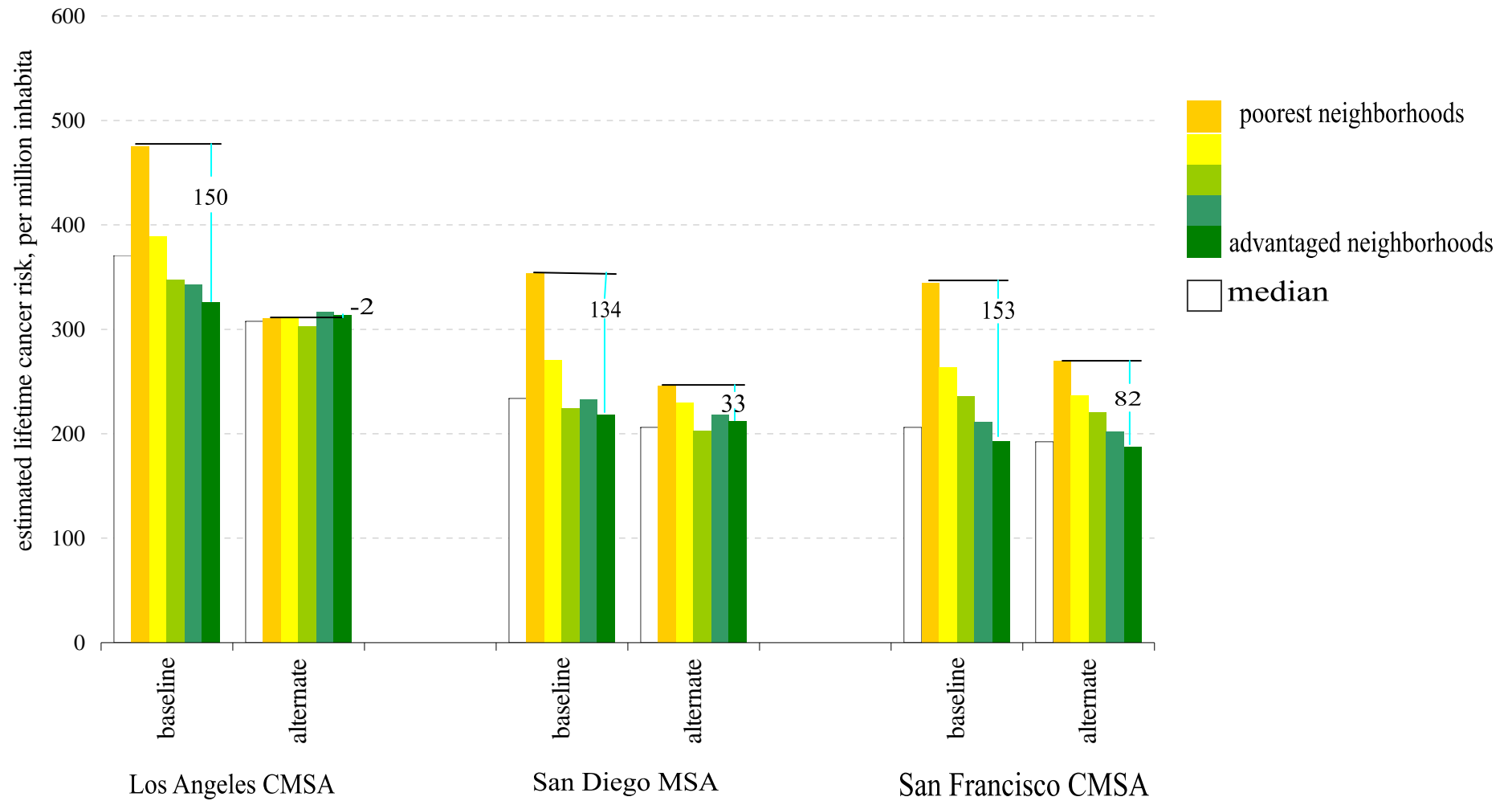
effect of cutting cancer risk from cumulative air toxics by 20%



effect of targeting most polluted areas:
cutting where cancer risk exceeds 200 per million by half



effect of targeting high poverty areas:
cutting cancer risk in proportion to poverty rate



Potential interventions

- Broadly applied interventions may decrease regional CI, but may not decrease inequality
 - Scenario 1
- Targeting interventions in highly impacted or highly vulnerable areas can decrease regional CI and decrease inequality
 - Scenarios 2 and 3

Conclusions

- Inequality impacts can be examined simultaneously within and between regions
- Enables assessments of vulnerability by different SES measures
 - Highlights opportunities and points of intervention
- Facilitates scenarios analysis
 - Inequality effects within & across regions
 - CI effects region-wide